CLAIMS

1. A method for dissociating ions in an ion trap, comprising the steps of switching a trapping voltage between discrete voltage levels to create a digital trapping field for trapping precursor ions and product ions in a trapping region of the ion trap, and injecting electrons into said ion trap while the trapping voltage is at a selected said voltage level whereby injected electrons reach the trapping region with a kinetic energy suitable for electron induced dissociation to take place.

2. A method as claimed in claim 1 wherein the initial kinetic energy of the injected electrons is reduced to said kinetic energy suitable for electron induced dissociation to take place after the electrons have entered the ion trap.

3. A method as claimed in claim 2 wherein said trapping voltage is switched between two discrete voltage levels.

4. A method as claimed in claim 1 wherein the electrons have a relatively low initial kinetic energy substantially suitable for electron induced dissociation, and are injected into said trapping region while the trapping voltage is at or close to zero volts.

5. A method as claimed in claim 4 wherein the trapping voltage has three discrete voltage levels and electrons are injected into said trapping region while the trapping voltage has the lowest absolute voltage value.

6. A method as claimed in any one of claims 1 to 5 including using a magnetic field to guide injected electrons to the trapping region.

7. A method as claimed in claim 6 wherein said magnetic field is generated using an electrical coil arranged to be energised by a pulsed current.

8. A method as claimed in any one of claims 1 to 7 wherein the ion trap is a 3-D quadrupole ion trap and electrons are injected into the trapping region through a hole in an end cap electrode of the ion trap.

9. A method as claimed in any one of claims 1 to 7 wherein the ion trap is a 3-D quadrupole ion trap and electrons are injected into the trapping region through a hole or slit in the ring electrode of the ion trap.

10. A method as claimed in any one of claims 1 to 7 wherein the ion trap is a linear quadrupole ion trap.

11. A method as claimed in claim 10 wherein electrons are injected along the longitudinal axis of the ion trap from one end of the trapping region.

12. A method as claimed in any one of claims 1 to 11 including introducing pulses of gas into the trapping region of the ion trap to cause collisional cooling of ions prior to or after dissociation.

13. A method as claimed in claim 12 wherein said pulses of gas are introduced into the trapping region using a pulsed valve and a vacuum pump capable of rapidly reducing the gas pressure to below 10^{-4}mbar.

14. A method as claimed in any one of claims 1 to 13 including applying a pulsed gate voltage to gating means to control extraction of electrons from an electron source for injection into said trapping region and synchronising

application of said pulsed gate voltage with the step of switching said trapping voltage to said selected voltage level.

15. A method as claimed in any one of claims 1 to 7 including applying a broadband dipole signal to the ion trap to remove product ions from the central region of the ion trap.

16. A method as claimed in any one of claims 1 to 7 including applying an AC dipole signal to the ion trap to selectively excite the precursor ions.

17. A method as claimed in any one of claims 1 to 16 wherein the trapped precursor ions include multiply-charged precursor ions, and the injected electrons have a kinetic energy less than 1eV and are capable of inducing electron capture dissociation of said multiply-charged ions.

18. A method as claimed in any one of claims 1 to 16 wherein the trapped precursor ions include multiply-charged precursor ions and including the step of introducing a gas into the trapping region of the ion trap whereby the injected electrons are captured by molecules of the gas and electrons are then transferred to the precursor ions to cause the dissociation.

19. An ion trap including switch means for switching a trapping voltage between discrete voltage levels to create a digital trapping field for trapping precursor ions and product ions in a trapping region of the ion trap, a source of electrons and control means for causing source electrons to be injected into said ion trap while the trapping voltage is at a selected one of said voltage levels, whereby the injected electrons reach the trapping region with a kinetic energy suitable for electron induced dissociation to take place.

20. An ion trap as claimed in claim 19 wherein said switch means is arranged to switch said trapping voltage between two discrete voltage levels.

21. An ion trap as claimed in claim 19 wherein said electrons have a relatively low initial kinetic energy substantially suitable for electron induced dissociation to take place and the electrons are injected into said trapping region while the trapping voltage is at or close to zero volts.

22. An ion trap as claimed in claim 21 wherein said switch means is arranged to switch said trapping voltage between three discrete voltage levels and said control means is arranged to cause injection of said electrons into the trapping region while the trapping voltage has the lowest absolute voltage value.

23. An ion trap as claimed in any one of claims 19 to 22 including means for generating a magnetic field for guiding injected electrons to the trapping region.

24. An ion trap as claimed in claim 23 wherein said means for generating a magnetic field comprises an electrical coil and means for energising the coil with pulsed current.

25. An ion trap according to any one of claims 19 to 24 in the form of a 3-D quadrupole ion trap, wherein electrons are injected into the trapping region through a hole or slit in an end cap electrode of the ion trap.

26. An ion trap according to any one of claims 19 to 24 in the form of a 3-D quadrupole ion trap, wherein electrons are injected into the trapping region through a hole or slit in the ring electrode of the ion trap.

27. An ion trap according to any one of claims 19 to 24 in the form of a linear quadrupole ion trap.

28. An ion trap according to claim 27 wherein electrons are injected along the longitudinal axis of the ion trap from one end of the trapping region.

29. An ion trap according to any one of claims 19 to 27 including a gas source for introducing pulses of gas into the trapping region to cause collisional cooling of ions prior to or after dissociation.

30. An ion trap as claimed in claim 29 wherein the gas source includes a pulsed valve and a vacuum pump capable of rapidly reducing gas pressure to below 10^{-4} mbar

31. An ion trap as claimed in any one of claims 19 to 30 wherein said control means includes gating means, means for applying a pulsed gate voltage to said gating means to control extraction of electrons from a said source of electrons, and means for synchronising application of said pulsed gate voltage with the switching of said trapping voltage to the selected voltage level.

32. An ion trap as claimed in any one of claims 19 to 24 including means for applying a broadband dipole signal to the ion trap to remove product ions from the central region of the ion trap.

33. A method of dissociating ions in an ion trap substantially as herein described with reference to the accompanying drawings.

34. An ion trap substantially as herein described with reference to the accompanying drawings.

35. A tandem mass spectrometer including an ion trap as claimed in any one of claims 19 to 32 and claim 34.